Bush River Watershed

MANAGEMENT PLAN

April 2003

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GIS DATA NOTE
Many of the GIS layers used in maps and analyses produced as a result of this report, were provided from three major sources: Maryland Department of Natural Resources, Harford County and the Maryland Department of Planning. Additional data analysis layers were created by the Center for Watershed Protection.

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EXECUTIVE SUMMARY

Located in Harford County, the Bush River watershed is approximately 117 square miles in size and is a tidal estuary to the Chesapeake Bay. It contains more than 520 miles of streams that flow through a wide variety of land uses that vary between urban, agriculture, forest and wetlands. A large portion of the watershed is located within the County's residential and industrial development envelope. Two major tributaries, Winters Run and Bynum Run currently deliver large amounts of sediment, nutrients and bacteria to the Bush River and with the recent development pressures, increased impacts from urbanization are anticipated within the watershed.

Over the last several years, there has been a significant effort put forth to attempt to assess and improve the overall health of both the tidal and non-tidal portions of the Bush River watershed. The Bush River Watershed Restoration Strategy (WRAS) has provided a framework for the consolidation of these efforts. The WRAS aims to identify pollutant sources, implement environmentally sensitive development techniques, increase community involvement and implement restoration and protection opportunities. This document details a major planning piece of this initiative, the Bush River Watershed Management Plan (WAMP). The goal of this WAMP is to concisely define a strategy for Harford County to pursue with respect to improving the overall conditions in the Bush River watershed. Specifically, the WAMP identifies and details:

- General management practices that can be applied across similar subwatershed types to improve watershed conditions and reduce pollutant loads
- Specific high quality subwatersheds that should be evaluated for future protection against development and enhancement with respect to riparian buffers and upland preservation efforts.
- Specific impacted subwatersheds within the development envelope that present opportunities for stormwater retrofits.
- Management approaches in both rural and urban subwatersheds that promote and encourage public awareness and involvement.

This report utilized an extensive amount of information provided by DNR and Harford County including data from the Bush River Watershed Characterization, Maryland Biological Stream Survey (MBSS), and Stream Corridor Assessment Methodology (SCAM). This data, supported with some additional calculations (current IC, future IC, etc) and field verifications (stream habitat, contiguous forest, and wetland evaluations), was to identify ten priority subwatersheds: Grays Run, Little East Bynum, West Branch, Middle Bynum, Lower Bynum, Plumtree Run, Otter Point DD, Church Creek DD, Bush Creek DD, and Haha Branch.

Recommendations and prioritizations were provided on a subwatershed basis as well as on an individual project or management measure basis (e.g., contiguous forest protection, riparian corridor reforestation, stormwater retrofits, and stream stabilization). A summary of recommendations are provided in Table E1.

Table E1. Summary of Bush River Watershed Management Recommendations	
Subwatershed Management Category	**Recommendation**
Sensitive	Preserve Contiguous Forests in all Sensitive Subwatersheds
Sensitive	Enhance Existing Riparian Buffer in all Sensitive Subwatersheds
Sensitive	Grays Run Contiguous Forest Preservation
Sensitive	Grays Run Stream Buffer Enhancement
Sensitive	Maintain Grays Run Sensitive Status
Sensitive	Field Verify and Prioritize Contiguous Forest Areas for Preservation
Rurally Impacted	Preserve Farmlands in Rurally Impacted Subwatersheds
Rurally Impacted	Restore Riparian Buffer in Rurally Impacted Subwatersheds
Rurally Impacted	Reduce Livestock Access in Little East Bynum
Rurally Impacted	Agricultural Practices Assessment in Rurally Impacted Subwatersheds
Rurally Impacted	Septic System Education in Rurally Impacted Subwatersheds
Impacted	Educate Residents on Watershed Stewardship in Impacted Subwatersheds
Impacted	Implement Stormwater Retrofits in Impacted Subwatersheds
Impacted	Conduct Stream Clean-ups in Lower and Middle Bynum
Impacted	Preserve Contiguous Forest in Lower Winters DD and Cranberry Run
Impacted	Investigate Other Stormwater Retrofit Opportunities in Impacted Subwatersheds
Impacted Special Resource	Preserve Large Wetland Tracts in Impacted Special Resource Subwatersheds
Impacted Special Resource	Implement Stormwater Retrofits in Impacted Special Resource Subwatersheds
Impacted Special Resource	Streambank Stabilization in Haha and Otter Point Subwatersheds
Impacted Special Resource	Develop a Heightened Plan Review in Impacted Special Resource Subwatersheds
Watershed-Wide	Establish an Implementation Committee
Watershed-Wide	Foster the Development of Bush River Watershed Association
Watershed-Wide	Create Watershed Stewardship Website
Watershed-Wide	Implement Recommendations of Harford County Site Planning Roundtable
Watershed-Wide	Establish an Adopt-a-Pond Program
Watershed-Wide	Improve ESC Implementation, Inspection and Enforcement

SECTION 1.0 WATERSHED PROFILE AND PROJECT BACKGROUND

SECTION 1.1 WATERSHED PROFILE

The Bush River Watershed is located in the south central portion of Harford County between Edgewood and the City of Aberdeen. The watershed is approximately 117 square miles and over 25% of the land in the County resides within the watershed (See Map 1)[1]. Approximately half of the City of Aberdeen and the entire incorporated limits of the Town of Bel Air are located within the watershed. The Bush River is a tidal estuary to the Chesapeake Bay and the major tributaries in the basin are Winters Run, Otter Point Creek, Bynum Run, James Run, Bush Creek and Church Creek (Map 2). The majority of the watershed is located in the Piedmont Plateau, while a small portion, southeast of Route 40, is located in the Coastal Plain. The watershed contains more than 520 miles of streams that flow through a wide variety of land uses that vary between urban, agriculture, forest and wetlands.

A large portion of the watershed is located within the County's residential and industrial development envelope, which follows the Route 40/I-95 corridor and extends northward to include the Route 24/Bel Air corridor. Winters Run and Bynum Run currently deliver large amounts of sediment, nutrients and bacteria to the Bush River, and with the recent development pressures, increased impacts from urbanization are anticipated within the watershed.

The Maryland Department of the Environment cites four impaired waterbodies in the Bush River Watershed on its 303(d) list: Bush River, Bynum Run, Atkisson Reservoir (located in the portion of Winters Run), and Aberdeen Proving Ground[2] (MDE, 2003). Causes of impairment include nutrients and suspended sediments. Aberdeen Proving Ground was also listed for toxic substances. Additionally, under Maryland's Clean Water Action Plan, both the Bynum Run and the Bush River watersheds have been listed as a Priority Category I Watershed (watersheds that are in most need of restoration).

SECTION 1.2 WATERSHED HISTORY

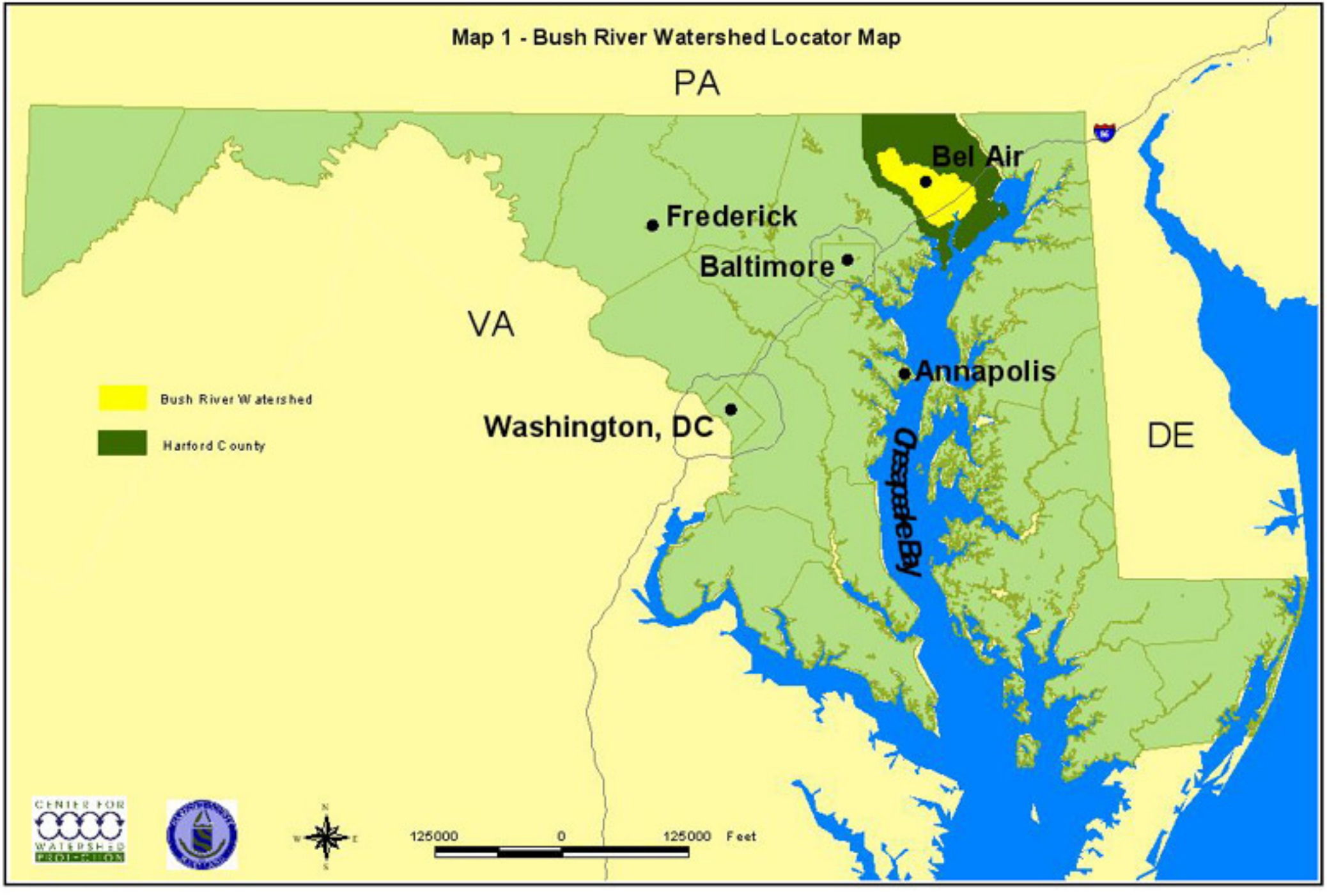
According to the 2000 Census, the population for Harford County was 226,565. The population has increased over 50% since 1980 and projections for 2020 estimate another 15% increase. Over the past 30 years, the greatest amount of development within Harford County has occurred in the Bush River watershed. Approximately 50% of the Harford County population resides within the Winters Run and Bynum Run drainage areas.

The placement of development within this geographic area has not been by chance. A "development envelope" was established in 1977 to direct development towards areas served, or planned for service, by public water and sewer[3]. By concentrating the majority of development within the development envelope, outlying areas may be preserved in a rural state to preserve the viability of agriculture in the County, as well as conserve other natural resources (See Map 2).

[1] Numbers specific to CWP analyses.

[2] Drainage from APG lands are not being considered in this analysis.

[3] Areas served by public sewer and water can accommodate a large portion of the County's population in medium and high density residential development. Services, such as police and fire, libraries, schools, can also be concentrated and serve the greatest number of people in the most efficient and cost-effective manner.


Map 1 - Bush River Watershed Locator Map
PA
Bel Air
Frederick
Baltimore
VA
Annapolis
Bush River Watershed
Harford County
Washington, DC
DE
Chesapeake Bay
CENTER FOR WATERSHED PROTECTION
125000
0
125000 Feet

Map 2 - Major Tributaries and Development Envelope in the Bush River Watershed

Many of the County's residents depend on the tributaries of the Bush River for their source of drinking water. The Town of Bel Air and surrounding areas use water withdrawn from Winters Run for their source of drinking water. Areas farther outside the Town of Bel Air on public water and sewer are supplied their drinking water from Harford County. The County drinking water is a mixture of water from several sources including water withdrawn from wells located in the Church Creek and Deep Spring Branch subwatersheds. Remaining residents within the Bush River watershed depend on groundwater for their source of drinking water through private wells.

As Harford County continues to grow, County planners, public works officials, and elected officials are increasingly aware of the delicate balance between a vibrant sustainable local economy and community and the fragility of important natural resources. Protection of environmental quality within the development envelope as well as beyond its boundary is important to the County, as it is clear that the quality of life of the citizens and visitors to the County goes hand in hand with the quality of the environment that surrounds them.

SECTION 1.3 PROJECT BACKGROUND

Over the last several years, there has been a significant effort put forth to attempt to assess and improve the overall health of both the tidal and non-tidal portions of the Bush River watershed. Various state, local and federal agencies and non-profit environmental groups have tried to accomplish this common goal, often working independently of each other, but more recently working cooperatively in a partnership fashion. The overall goal of the partnership is to develop a strategy to improve impacted watershed conditions in order to meet Class I water quality standards in the Bush River watershed through implementation of environmentally sensitive development techniques and promotion and encouragement of community awareness in the watershed.

In September 2002, the Maryland Department of Natural Resources (DNR) completed a Bush River Watershed Characterization Report[4] in support of Harford County's Watershed Restoration Action Strategy (WRAS), which went a long way towards consolidating and summarizing existing information and data collection efforts. As a supplement to the standard data compiled and presented in the Characterization Report, the County also arranged for DNR to collect and compile more detailed nutrient, benthic macroinvertebrate and fish synoptic data.

In addition, a County-wide initiative focusing on environmentally sensitive development is currently underway. In cooperation with the Harford County Department of Planning and Zoning and the Home Builders Association of Maryland, the Center for Watershed Protection and the Alliance for the Chesapeake Bay kicked off a yearlong roundtable process starting in September 2002 as part of the *Builders for the Bay* agreement. During the roundtable, representatives from the development and environmental communities, county and municipal governments, civic and nonprofit organizations, and business groups will review existing codes and ordinances and determine which should be revised to better protect the area's water resources and aquatic communities while allowing for economic growth. Through a consensus process, recommendations by the roundtable will be made to the County, which will then work

[4] This document does not attempt to reiterate the wealth of information presented in the Characterization Report. Rather, the reader is encouraged to refer to the report for many of the "big picture" findings presented in the document.

to incorporate those principles into County subdivision and commercial development practices. A final consensus document is expected to be completed by June 2003.

The third major planning piece of the Bush River initiative is the development of a Bush River Watershed Management Plan (WAMP), which this document details. The purpose of the WAMP is to utilize the WRAS data, aerial photos, and other related GIS data layers to develop stream and habitat restoration guidance in the watershed and to identify subwatershed areas where priority restoration and rehabilitation is warranted.

The primary vehicle used to develop the Bush River WAMP is a watershed vulnerability analysis, which enables larger watersheds like the Bush River to be rapidly assessed so that subwatersheds most vulnerable to current and future land development and management problems can be identified for prioritization of management efforts. The vulnerability analysis is also a useful tool to heighten public awareness in the watershed as it can distill key issues and pressures facing the watershed and allow general management approaches to be applied to subwatersheds with similar conditions.

SECTION 1.4 WAMP GOALS

The Bush River watershed is a unique and complex watershed in the Chesapeake Bay region because it contains large tracts of both urban and rural land uses. Consequently, management measures will need to be aligned with these different parameters and will take on vastly different approaches. For example, rural/agricultural subwatershed management practices typically emphasize land conservation, riparian enhancement, and nutrient management techniques, while urban subwatershed management practices generally emphasize stormwater retrofitting, pollution prevention, public education, and streambank stabilization techniques.

The goal of this WAMP is to concisely define a strategy for Harford County to pursue with respect to improving the overall conditions in the Bush River watershed. Overall watershed impairments have previously been identified in Maryland Biological Stream Survey (MBSS, 2001) and Characterization reports on the Bush River and typically involve excess nutrient loads, poor habitat quality, and channel instability. Therefore, the focus of the WAMP is to:

1. Identify general management practices that can be applied across similar subwatershed types to improve watershed conditions and reduce pollutant loads
2. Identify specific high quality subwatersheds that should be evaluated for future protection against development and enhancement with respect to riparian buffers and upland preservation efforts.
3. Identify specific impacted subwatersheds within the development envelope that may lend themselves to stormwater retrofits.
4. Identify management approaches in both rural and urban subwatersheds that promote and encourage public awareness and involvement.

SECTION 1.5 IMPERVIOUS COVER AS A SCREENING TOOL

Perhaps the most useful screening parameter in watershed assessment is impervious cover. Impervious cover is defined as the sum of all surfaces within the watershed that do not allow

water to infiltrate through the ground. Examples include roadways, driveways, houses, sidewalks, and parking lots that are covered by concrete, asphalt or other impermeable surface. In recent years, impervious cover has emerged as a key indicator to explain and sometimes predict how severely streams change in response to different levels of watershed development (CWP, 2003). The Center has integrated these research findings into a general watershed planning model, known as the impervious cover model (ICM) (Figure 1). The ICM predicts that most stream quality indicators decline when watershed impervious cover exceeds 10%, with severe degradation expected beyond 25% impervious cover. The model classifies subwatersheds into one of three categories: sensitive, impacted, and non-supporting.

Sensitive subwatersheds have an impervious cover of 0 to 10 percent. Consequently, streams in these subwatersheds are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects (CWP, 1998). The main goal for these types of subwatersheds is to maintain predevelopment stream biodiversity and channel stability.

Impacted subwatersheds have an impervious cover ranging from 11 to 25 percent and show clear signs of degradation due to watershed urbanization. Greater storm flows have begun to alter the stream geometry. Both erosion and channel widening are evident. Stream banks become unstable, and physical habitat in the stream declines noticeably. Stream biodiversity declines to fair levels, with the most sensitive fish and aquatic insects disappearing from the stream (CWP, 1998). The main goals for these types of subwatersheds are to limit the degradation of stream habitat quality and maintain a good biological community.

Non-supporting subwatersheds have an impervious cover greater than 25 percent. Streams in this category essentially become a conduit for conveying stormwater flows, and can no longer support a diverse stream community. The stream channel becomes highly unstable, and many stream reaches experience severe widening, down-cutting and streambank erosion. The water and biological quality of non-supporting streams is generally considered poor, and is dominated by pollution tolerant insects and fish. The goals for these subwatersheds are to minimize downstream pollutants, alleviate downstream flooding, and improve aesthetic appeal.

The ICM has proven to be an extremely important tool for watershed planning, since it can rapidly project how streams will change in response to future land use. The Center routinely estimates existing and future impervious cover in our watershed planning approach, and find that it is an excellent indicator of change for subwatersheds from 0 to 30%, which is the range where the Bush River subwatersheds fall.

The ICM often forces watershed plans to directly confront land use planning and land conservation issues early in the planning process; however, impervious cover is not a perfect indicator of existing stream quality. A number of additional stream and subwatershed criteria should be evaluated in the field before a final classification decision is made, particularly when the stream is on the borderline between two classifications. Some of the additional criteria might include: reported presence of rare, threatened or endangered species; fair to good, good, or good to excellent macroinvertebrate scores; stream channels with little evidence of ditching, enclosure, tile drainage or channelization; fair-to-good stream habitat scores; significant conservation areas; large contiguous forest tracts; farming, ranching and livestock operations using best management practices; and prior development with stormwater best management practices.

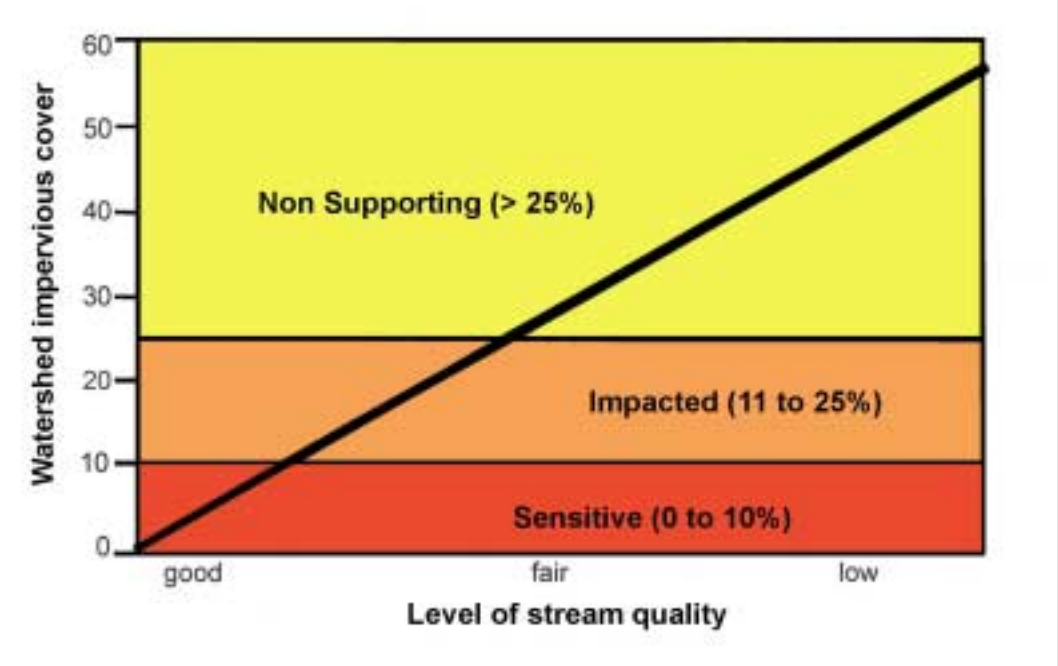


Figure 1. The Impervious Cover Model

The ICM is based on the following assumptions and caveats. The ICM:

1. Applies only to 1st, 2nd and 3rd order streams;

2. Requires accurate estimates of percent impervious area, which is defined as the total amount of impervious area over a subwatershed area;

3. Predicts potential rather than actual stream quality. It can and should be expected that some streams will depart from the predictions of the model. While impervious cover (IC) can be used to initially diagnose stream quality, supplemental field monitoring is recommended to actually confirm it;

4. Does not predict the precise score of an individual stream quality indicator, but rather predicts the average behavior of a group of indicators over a range of IC. Extreme care should be exercised if the ICM is used to predict the fate of individual species (e.g., trout, salmon, mussels);

5. Athresholds@ defined as 10 and 25% IC, are not sharp Abreakpoints,@ but reflect instead the expected transition of a composite of individual indicators in that range of IC. Thus, it is virtually impossible to distinguish real differences in stream indicators within a few percentage points of watershed IC (e.g., 9.9 vs. 10.1%);

6. Should only be applied within the ecoregions where it has been tested, including the mid-Atlantic, Northeast, Southeast, Upper Midwest, and Pacific Northwest;

7. Has not yet been validated for non-stream conditions (e.g., lakes, reservoirs, aquifers and estuaries). Additional locally-based research is needed to adapt the ICM model for these conditions; and

8. Is conservative in that it does not predict the potential mitigating impact of watershed treatment practices. At this time, researchers are not sure that they can detect the impact of watershed treatment, and none has gone so far as to assert that it dramatically shifts the basic ICM.

SECTION 1.6 THE SCALE OF WATERSHED PLANNING AND THE SUBWATERSHED APPROACH

An effective watershed plan for the Bush River requires an understanding of the dynamics of the entire watershed, including its environmental status, growth in residential and commercial sectors, and agricultural land management practices. However, it is important to understand that developing watershed management plans at the scale of the Bush River watershed (i.e., over 100 square miles) is a particularly challenging task and limited by available resources for assessment and analysis. Furthermore, it is generally difficult to develop specific management recommendations that can easily proceed towards implementation without first analyzing at the subwatershed level. Consequently, the preferred and recommended assessment approach involves working with a smaller management unit, on the order of 10 square miles (CWP, 1998). From a naming convention standpoint, this management unit will be referred to as a subwatershed in this document (refer to Figure 2 and Table 1).

Subwatersheds are the preferred unit for developing watershed plans because they are sensitive to the influence of impervious cover, generally enable the distinction between pollutant sources to be made, generally are contained within a single jurisdictional boundary, and allow for a rapid approach to mapping, monitoring, and other subwatershed assessment steps. The Center, in coordination with County staff delineated the Bush River watershed into 19 subwatersheds for this project. Map 3 shows the delineations and Section 2.1 provides a detailed description of the factors that were considered when developing the delineation.

In an effort to balance the common management and planning challenges that arise from assessing large watersheds, the Center applies an assessment tool called the watershed vulnerability analysis to serve as a preliminary screening tool that identifies subwatersheds that are most vulnerable to current and future land development and management problems (thus the term "vulnerability analysis"). This process is described in more detail below.

Table 1. Description of the Various Watershed Management Units

Unit	Typical Area (square miles)	Influence of Impervious Cover
Catchment	0.05 to 0.50	very strong
Subwatershed	1 to 10	strong
Watershed	10 to 100	moderate
Subbasin	100 to 1,000	weak
Basin	1,000 to 10,000	very weak

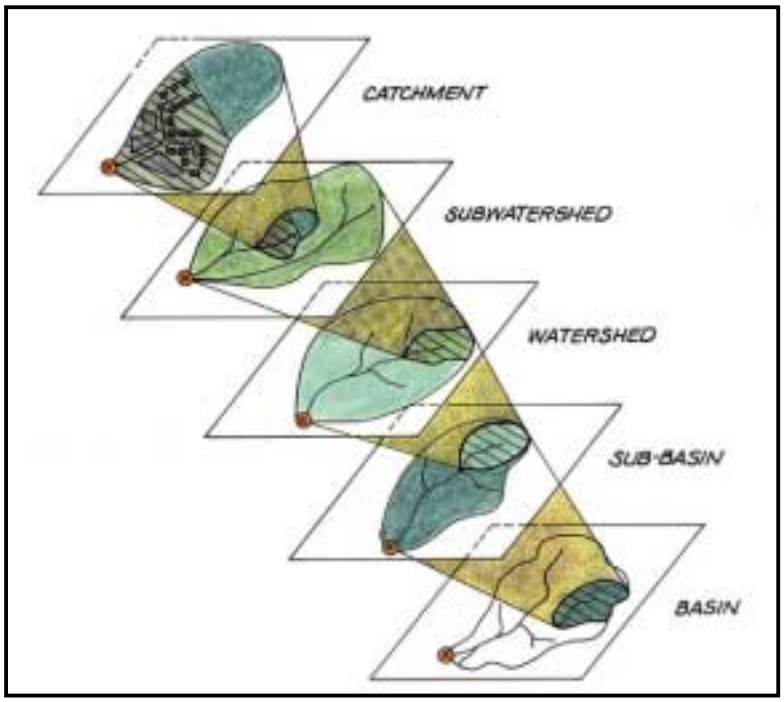


Figure 2. Units for Watershed Assessment and Management

SECTION 1.7 VULNERABILITY ANALYSIS APPROACH IN THE BUSH RIVER WATERSHED

A vulnerability analysis determines key watershed management issues, compiles, and combines detailed information in order to prepare plans to protect and restore vulnerable subwatersheds within the Bush River watershed. While specific management recommendations are generated for targeted subwatersheds, more detailed follow-up studies are generally warranted prior to implementation.

Within the context of the Bush River watershed, vulnerability can have several definitions, depending on the characteristics of a particular subwatershed. For example, high quality subwatersheds are vulnerable to even small land use changes. Some subwatersheds within Bush River are termed vulnerable because of the impact of current and planned future development. Lastly, others are deemed vulnerable due to the impacts of rural land management practices, unrelated to development pressure.

The foundation of a watershed vulnerability analysis is existing watershed information and GIS data. Land use and impervious cover estimates serve as the starting point of the analysis. Biological, physical, and chemical data are then used to refine the analysis. Therefore, the more good quality data that are available, the more reliable the assessment and recommendations will be. In the case of the Bush River, excellent watershed-wide data exists from a variety of sources, including: DNR's WRAS data, Harford County Stream Corridor Assessment Method (SCAM) data, MBSS data, and 2000 aerial and planimetric data. Table 2 illustrates the variety of data that are available for the watershed.

Table 2. Current Conditions in Bush River Watershed	
Watershed Factor	**Current Conditions**
Total Area	117 square miles (74,880 acres)
Number of Subwatersheds	19
Mapped Perennial Stream Miles	521 miles
Current Impervious Cover	11%
Future (buildout) Impervious Cover	18%
Estimated Forest Area (based on 2000 MDP[1])	23,579 acres (31% of watershed)
Forested Streamside (100 feet on either side of stream)	6310 acres (8% of watershed)
Protected Land (includes ag easements, private easements, MET, parks, and DNR land)	3,841 acres (5% of watershed)
Forested Protected Land	1,630 acres (2% of watershed)
Potentially Developable Area within the watershed	32,947 acres (44% of watershed)
Development Envelope within the watershed	36,691 acres (49% of watershed)
Agricultural Characteristics (based on 2000 MDP)	4% Pasture (2,631 acres) 27% Cropland (19,988 acres)
MDP: Maryland Department of Planning Land Use/Land Cover MET: Maryland Environmental Trust	

The vulnerability analysis is organized into the following five primary steps:

1) Delineation of subwatersheds.
2) Calculating current impervious cover.
3) Determining future impervious cover.
4) Scaling and utilizing other screening factors for further characterization.
5) Prioritizing subwatersheds.

Once subwatershed delineations are made, the amount of current and future impervious cover is calculated using current GIS data layers and projections from zoning ordinances and comprehensive plans. Subwatersheds are initially classified solely on impervious cover, using the ICM.

Next, other watershed information is evaluated to further refine the initial classifications. This step is particularly important in watersheds with significant areas of rural or agricultural land use. For example, research on streams in the Georgia Piedmont indicated that other watershed factors such as forest and agricultural cover are useful indicators of stream quality (Divivo, 1997) (see Figure 3). Agricultural reference streams had lower Index of Biotic Integrity (IBI) scores than similar forested reference streams. Therefore, even when a subwatershed has low impervious cover levels that initially classify it as a "sensitive" subwatershed, there may be other influences that cause the biological community to show signs of degradation and stress. Under the vulnerability analysis approach, these subwatersheds might be shifted to the "impacted" designation for planning and management purposes.

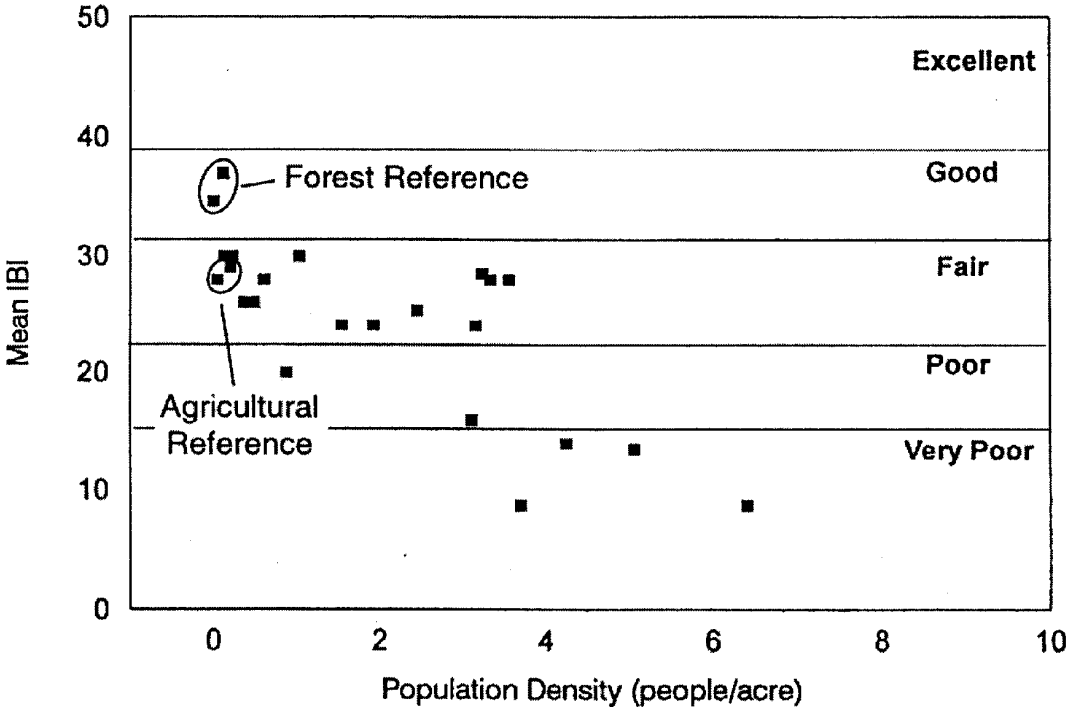


Figure 3. Impacts of Urbanization and Agriculture on IBI Scores (Divivo *et al.*, 1997)

Existing data and field verification revealed that there are really four different subwatershed types within the Bush River watershed: Sensitive, Rurally Impacted, Impacted, and Impacted Special Resource. To initially classify these subwatersheds, a uniform and quantitative approach was developed for further evaluation of the health the subwatersheds. The method incorporated utilized a variety of in-stream and subwatershed factors and required assigning points based on the presence of a given factor. Specific factors included: forested streamside, protected lands, and agricultural land uses. Details on these scoring methods and a summary table for each of the subwatersheds are provided in Section 2.4.

Based on this analysis, the current and future status of many of the subwatersheds were revised and resulted in the reclassification into one of the four management categories. The quantitative approach for the other analysis factors enabled a preliminary prioritization to be made, where 10 subwatersheds were identified and considered the most vulnerable. Management recommendations are detailed for these priority subwatersheds in Section 3.0.

SECTION 1.8 DOCUMENT ORGANIZATION

The remainder of this Bush River Watershed Management Plan document is organized as follows:

Section 2 – This section details and summarizes all of the key watershed and subwatershed data that were analyzed and considered in the development of the management plan. General

findings are also presented from the assessments conducted. Field verifications and retrofit inventories were conducted and detailed in this section in support of the initial findings.

Section 3 – Management recommendations on a subwatershed and land use basis are presented in this section.

Section 4 –Implementation of specific management recommendations are presented in this section.

Section 5 – The last section provides guidance on what types of approaches can be employed to serve as measures of success as recommended management measures are implemented in the watershed.

Section 6 – Conclusion

Section 7 – References